ICE DEVELOPMENT ON LAKE CHAMPLAIN

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This report describes a significant result under NASA resource category 4, I; Lake Ice Surveys.

SIGNIFICANT RESULT SUMMARY

4.I: Lake Ice Survey

Only one usable ERTS-1 scene was available for lake ice survey of Lake Champlain. The January 8, 1973, coverage (Image No. 1169-11521) revealed the presence of various ice tones, patterns, and arrangements as well as open water. MSS band 5 imagery provided the most useful data. While it was not possible to differentiate open water from one - two-day old) ice, which only occurred over a small portion of the lake area, it was possible to interpret the tonal signatures of the frozen portion in terms of freezing history or age. The dark gray-tones of new, smooth, ice contrasts with the medium gray-tones of older ice, and the rough texture of wind-jammed bay ice. Mapping of these ice patterns seems quite feasible with moderate enlargement of the scene (2 to 3X).

BACKGROUND

It was anticipated that ERTS-1 imagery would provide some data on ice conditions in Lake Champlain which might lead to developing a model of the lake freezing process during winter as well as the progression of melting in Spring. Weather conditions during these periods involves a high incidence of cloudy weather associated with cyclonic storms and fronts, this for the winter of 1972-73, one good ERTS scene was obtained. At such a rate, it would appear that in order to document the lake ice freeze-thaw cycles adequately from ERTS, approximately three winter cycles might be needed. However, since the one ERTS scene obtained during the past winter is of excellent quality and shows considerable variation in the tone, pattern, and arrangement of ice features, some indication of ice development can be interpreted from this variation. The lake generally freezes over completely by mid-February, and it is only a rare occurrence when the lake does not completely freeze. No usable ERTS data are available for documenting the thaw process for the lake.

ERTS IMAGERY AND INTERPRETATION

Figure 1 shows a slightly enlarged (1:800,000) scene from the one good winter ERTS image. This figure is the MSS band 5 rendition of January 8, 1973 (Image No. 1169-15121) reproduced on Polaroid Type 52 film. Further enlargement of this scene by 2 to 3 X would allow for mapping ice extent and type on base maps of the lake. The MSS band 5 image provided maximum contrast, whereas the infrared bands (MSS bands 6 and 7) provided much less by way of ice detail. As would be expected, the infrared bands provide maximum contrast for shoreline location.

The tonal variations as seen in Figure 1 appear to relate directly to the age of the ice and its previous history, as well as to areas of open water. Field investigation revealed that the greatest difficulty is

Figure 1. Ice development on Lake Champlain. The slightly enlarged (1:800,000) scene from January 10, MSS band 5 imagery shows various ice types and the extent of open water nearly covered with evaporation clouds (bottom center).

the differentiation of open water from new clear ice. The weather conditions attending the ERTS scene were ideal for rapid formation of new ice with daily temperature ranges of -10° to + 10° F. Areas of new ice observed from the ground had formed in several areas, but apparently the reflectance difference between the new, thin, ice and adjacent open water was negligible. Investigation of image enhancement procedures will be required in order to see if the differences can be brought out sufficiently to define the ice-water margins. The general area of open water can be recognized by the evaporation clouds over the main portion of the lake (bottom center of Figure 1).

The age and conditions of formation of lake ice is indicated by its tonal signature, so that dark gray-tones of smooth, relatively new ice, progress toward lighter gray-tones indicative of older ice with some wind-swept snow cover. Rougher textures in some areas are due to wind-jammed ice floes which freeze together to form rough ice.

In general, the progression of freezing may be determined by the progression of gray tones described above which indicates that the Northeast sector of the lake, with its numerous bays and shallow water, freezes first. The portion of the lake south of Grand Ile remains open the longest. The detailed pattern of ice development can now be mapped and compared with future ERTS scenes and applied to resource considerations.